

C1 Hungry plants

Learn about:

● Photosynthesis

Where do plants get food?



Plants need food to respire and to grow, but how do they get this food?



I think that plants take in all their food through their roots.

I think that plants make their own food using energy from the Sun.

I think that plants make their own food from carbon dioxide and water.

- a** Which of these ideas on the right do you agree with?
- b** What evidence would you need to collect to work out who is correct?



Matthew



Andrew



Jenny

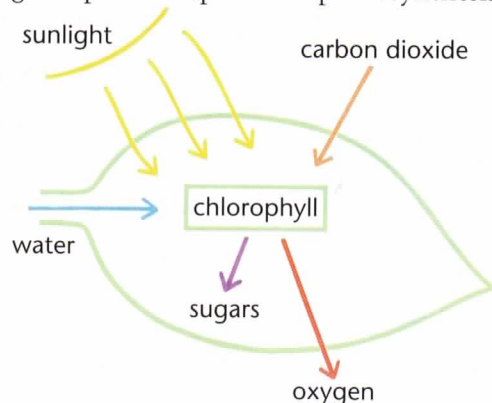
In fact, both Andrew and Jenny are correct. Plants make their food in their leaves from carbon dioxide and water, using energy from the Sun. This process is called **photosynthesis**.

In the early 1600s, a Dutch scientist called Jan van Helmont carried out an experiment with a willow tree. Van Helmont filled a tub with 90.72 kg of soil, which had been dried in an oven. He planted a willow tree in the tub. The tree weighed 2.28 kg. To stop anything getting into the tub, he covered the surface of the soil. He kept it watered by adding only rainwater. Five years later he removed the tree and weighed it again; it weighed 77.51 kg. He then dried and weighed the soil; it weighed 90.67 kg.

- c** Compare the increase in the mass of the tree to the decrease in the mass of the soil. What does this tell you?
- d** Where could the extra mass of the tree come from?

How does photosynthesis work?

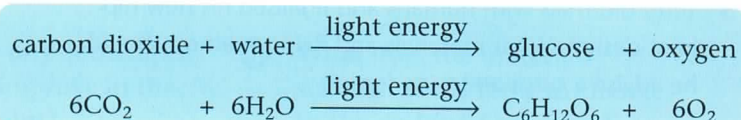
In photosynthesis, plants change carbon dioxide and water into oxygen and a sugar called glucose. They use the glucose for food. This change needs light energy from the Sun. Photosynthesis happens mainly in the leaves, though all the green parts of a plant can photosynthesise.



Did you know?

In the eighteenth century, the Dutch scientist Jan Ingenhousz was the first to discover that plants take in carbon dioxide and release oxygen when sunlight shines on them.

Jenny drew this diagram to show exactly what happens in photosynthesis. The light energy is transferred to the glucose as chemical energy. She wrote out the word equation and symbol equation.



How does light affect plants?

In Jessica's house there is a plant in every room. She thinks it makes the house look nice, but she can't work out why the plant in the living room grows more quickly than the plant in the hallway.

Using what you know about photosynthesis, answer this question for Jessica.

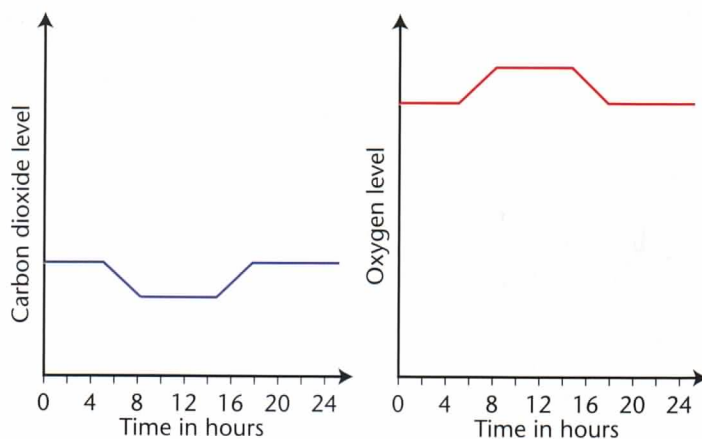
- e** Which plant can photosynthesise most quickly? Explain why.



Growing plants in a greenhouse

Anki lives in Holland. She grows flowers in greenhouses, and sells them all over the world. She wants to check at what times of day her plants are photosynthesising well. She can then supply extra carbon dioxide into the air in the greenhouse at these times, to help the plants photosynthesise even better. Many growers do this in their greenhouses so that the plants grow quickly.

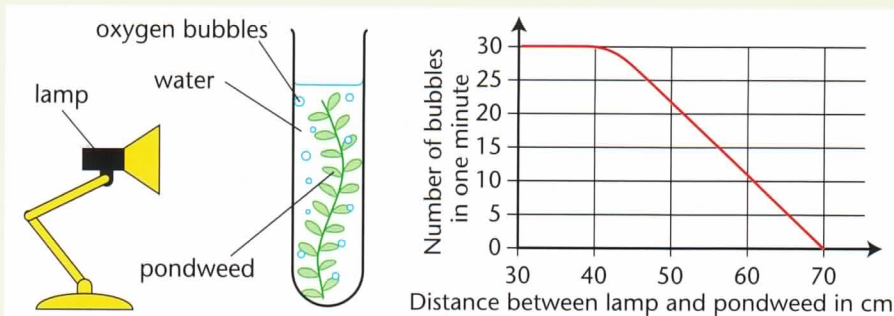
Anki measured the carbon dioxide and oxygen levels in her greenhouses, and plotted these graphs on the right.



- f** Between what times does photosynthesis stop? Explain how you worked this out.
- g** At what time of day is photosynthesis happening most quickly?
- h** When should Anki pump carbon dioxide into her greenhouses?

Questions

- Why do plants photosynthesise?
- Look back at the equations for photosynthesis. Suggest two reasons why humans couldn't survive without plants.
- Look at the experiment below. Tariq altered the distance between the lamp and the plant. He counted the number of bubbles of oxygen produced in one minute at each distance. He plotted his results on this graph.
 - As the lamp got further away from the pondweed, what happened to the number of bubbles produced in one minute?



- As the lamp got further away from the pondweed, what happened to the speed of photosynthesis?
- Tariq studied his graph carefully. He realised that when the lamp is quite close to the plant, it doesn't matter how much closer you move the lamp, the speed of photosynthesis stays the same. Suggest a reason to explain this.

Did you know?

If you gave anyone flowers recently, it's very likely that they were grown in Holland. The Dutch are one of the biggest exporters of flowers in the world.

For your notes:

- Plants make food by a process called **photosynthesis**. This happens mainly in the leaves.
- In photosynthesis, plants take in carbon dioxide and water and use light energy to make oxygen and a sugar called glucose.

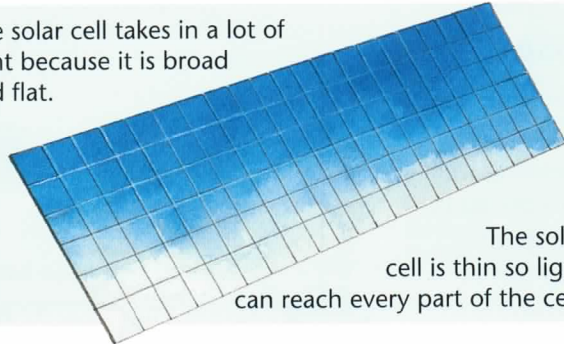


Catching the Sun

Look at the photo of the house. It is very 'eco-friendly'. Solar cells on the roof use light energy to produce electricity. They are electrical cells which make electricity when light hits them.

Solar cells are flat, and they have a large surface area. This makes them very good at taking in light. Because they are thin, light can reach every part in the cell.

The solar cell takes in a lot of light because it is broad and flat.



The solar cell is thin so light can reach every part of the cell.



Looking at a leaf

A **leaf** is a plant organ that has a very similar function to a solar cell. Both of them need a lot of light energy to work. Plants need light energy for photosynthesis, which happens in the chloroplasts inside the cells of the leaf. Chloroplasts contain **chlorophyll**, a green pigment which takes in energy from the sunlight. All the green parts of a plant are able to photosynthesise to some extent because they contain chlorophyll.

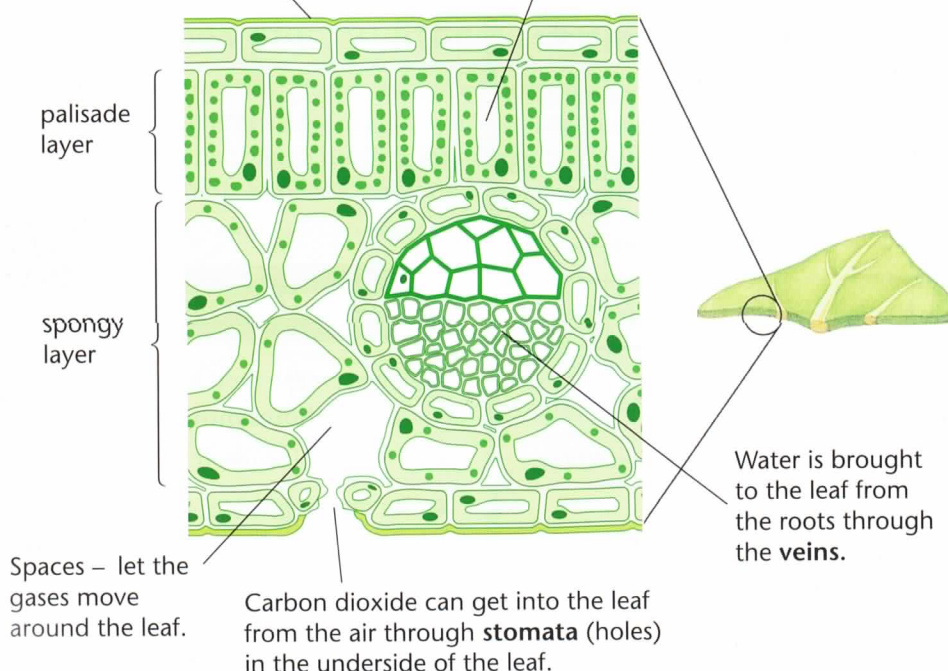
Look at this photo of leaves.

- In what two ways are solar cells and leaves similar?
- Why do you think that nettles growing in the shade often have broader leaves than nettles growing in the light?



Plants can lose water through their leaves but the waxy, waterproof layer stops water loss from the top surface.

Light can get to the chloroplasts easily. Most of the chloroplasts are in the palisade layer of cells, near to the top of the leaf where the light comes in.



Looking close up

It's not just the shape of a leaf that is important. The cells of the leaf also help photosynthesis happen easily. We can slice a leaf open, and have a look at the cells inside it using a microscope. The cells are specialised to make photosynthesis as efficient as possible.

- The top layer of cells is transparent. Why is this?
- What are the veins for?

In any living thing, different cells have different functions. Cells are specialised to carry out their functions. This means they have special features to help them. Palisade cells are specialised for photosynthesis:

- They have lots of chloroplasts, which contain chlorophyll. Chlorophyll catches light energy, and so cells with lots of chlorophyll can photosynthesise well.
- They are long and thin. This means lots of palisade cells can pack tightly together, making sure that they catch as much light energy as possible.
- They are at the top of the leaf to make sure they get as much light as possible.

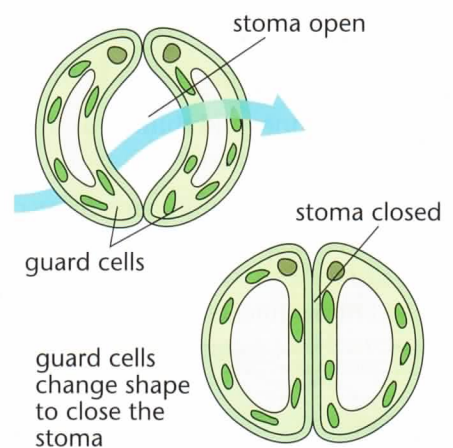
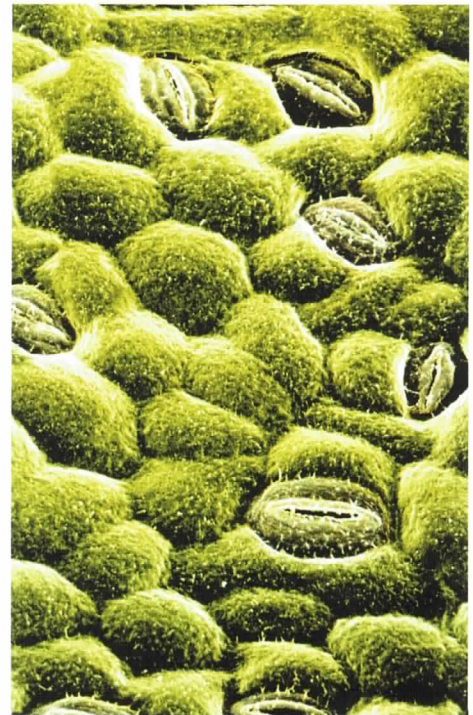
Gases in and out

Look at the leaf diagram again. Can you see the holes on the underside of the leaf? These holes are called stomata (one hole is a stoma). You can see them under the microscope in this photo.

The carbon dioxide for photosynthesis goes into the leaf through the stomata. The oxygen made by photosynthesis diffuses out of the palisade cells and into the spaces of the spongy layer before leaving the leaf through the stomata. The gases diffuse in and out of the leaf.

The cells on either side of a stoma are called guard cells. They are specialised to change shape to open or close each stoma. Look at the picture on the right below. The guard cells control the amount of carbon dioxide and oxygen that goes in and out of the leaf.

- e** Write down the parts of the leaf through which carbon dioxide travels on its way from the air outside the leaf to the chloroplasts in the palisade cells.



Questions

- Write down as many similarities as you can think of between a leaf and a solar cell.
- How are the palisade cells specialised for photosynthesis?
 - How does the shape of the leaf help with photosynthesis?
 - What is the function of the air spaces in the spongy layer of the leaf?
- Explain the function of stomata in leaves.
 - How are the guard cells specialised for their function?
- Look at this picture of a variegated leaf. It has chlorophyll only in the cells towards the centre of the leaf.
 - In which part of the leaf does photosynthesis happen?
 - Suggest how the cells without chlorophyll stay alive if they cannot make their own food.



For your notes:

- **Leaves** are thin and have a large surface area, so every cell receives as much sunlight as possible.
- The structure of a leaf is adapted so it can photosynthesise well.
- The cells in a leaf are specialised to carry out particular functions to help with photosynthesis.